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Clinical Questions and Demands for Imaging of Extracerebral Paediatric Malignancies in Primary Diagnosis and Follow-up

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Needs and challenges for diagnostic imaging in paediatric oncology are primarily based on the detection of malignant tumours, confirmation of specific tumour entities, correct staging, therapy monitoring, and staging at follow-up. In children and adolescents, most important malignancies are acute leukaemias (34%), brain tumours (20%), lymphomas (13%), neuroblastomas (9%), soft tissue sarcomas (7%), nephroblastomas (6%), bone tumours (5%), and germ cell tumours (3%). With chemotherapy, surgery and/or irradiation, a 5-years event-free survival rate of about 75% has now been achieved[1]. However, especially in patients with solid tumours, comprehensive and exact imaging at primary diagnosis and during treatment is essential for scheduling the intensity of therapy and, therefore, is extremely relevant for event-free survival.

For a basic evaluation, paediatric oncologists order a chest x-ray and an ultrasound examination of the abdomen, since both examinations are rapidly available. However, further evaluation with chest CT and abdominal MRI are mandatory and now a standard procedure in paediatric oncology. For bone tumours or metastases, Tc-^{99}m-DPD-scintigraphy is still recommended in the German or European study protocols[1]. However, as only osteoblastic tumours or metastases are detectable by Tc-^{99}m-DPD, the clinical question is, whether bone scintigraphy is still necessary or could be replaced by FDG-PET[2]. Paediatric tumours utilise glucose as substrate. Therefore, PET imaging with FDG can be used for detecting active tumours in the whole body and not only in the bone. In about 80% of patients with neuroblastoma, the diagnosis is confirmed by elevated catecholamines in the urine and a positive ^{123}I-MIBG-scintigraphy. However, in case of a negative ^{123}I-MIBG-scintigraphy, the study protocol recommends a Tc-^{99}m-DPD-scintigraphy for detecting bone metastases or an ^{111}In-Octreotide scintigraphy[1]. In case of a positive ^{123}I-MIBG-uptake in the bone, a Tc-^{99}m-DPD-scintigraphy is recommended for discriminating bone from bone marrow metastases. The clinical question is, whether FDG-PET could replace Tc-^{99}m-DPD-scintigraphy and ^{111}In-octreotide scintigraphy in ^{123}I-MIBG-negative neuroblastomas. Lesions found by FDG-PET have to be confirmed by CT or MRI. The question is, whether a combined PET-CT or PET-MRI is helpful for a better staging in the future in paediatric cancer patients[3].

In paediatric oncology, neoadjuvant chemotherapy with delayed surgery has become the standard procedure in most solid tumours since response to chemotherapy is a significant marker for long-term survival. For example, in osteosarcoma, definitive surgery is delayed to week 10 after diagnosis. The histological response at that time with <10% vital tumour cells resembles good response[1]. The clinical question is, whether FDG-PET can be correlated with such responses to get another tool for evaluating chemotherapy response[3]. In the current prospective EuroNet-PHL-C1 protocol[1] for children and adolescents with Hodgkin`s disease, FDG-PET has already been implemented as a tool for chemotherapy response without histological confirmation. With a negative FDG-PET after 2 courses of chemotherapy, patients do not receive irradiation at the end of intensive chemotherapy[4].

In conclusion, for the assessment of paediatric malignancies we need a comprehensive and exact diagnostic work-up with both morphological and functional imaging modalities. However, the question is which modality has to be used or can be passed on during primary diagnosis, therapy monitoring, and follow-up.

References

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